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Dictyotrichocladium aquaticum gen. & sp. nov. and *Minimelanolocus aquatilis* sp. nov. from freshwater in Brazil's semiarid region

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Abstract—A new genus and species, *Dictyotrichocladium aquaticum*, is described and illustrated from submerged decaying leaves of *Calophyllum brasiliense* in the Brazilian semiarid region; it is distinguished by macronematous, sometimes micronematous conidiophores, and monoblastic, terminal conidiogenous cells that produce solitary, long pyriform, cylindrical, long clavate, turbinate to vermiform, curved or sigmoid, dictyoseptate, black or dark pigmented conidia that usually do not secede but remain attached after maturation. A new species, *Minimelanolocus aquatilis*, characterized by obclavate, 3–5-euseptate, verruculose, pale brown conidia, is described and illustrated from decaying twigs of an unidentified plant in the Brazilian semiarid region.

Key words—aquatic fungi, Caatinga, taxonomy, tropics

Introduction

Freshwater hyphomycetes, which are essential for recycling complex organic matter in aquatic environments (Jones & Pang 2012), have part or entire life cycles in water (Thomas 1996). Goh & Hyde (1996) delineated three freshwater groups: the Ingoldian fungi, the aero-aquatic hyphomycetes, and the facultative aquatic hyphomycetes. The present study focused on facultative aquatic hyphomycetes that include hyaline dematiaceous genera producing conidia that are mainly unmodified by aquatic environments (Goh & Hyde 1996, Shearer et al. 2007).

In Brazil, the first taxonomic research on facultative aquatic hyphomycetes occurred in the Brazilian semiarid region (Caatinga) and was followed by explorations in the Amazon and Atlantic Forest (Barbosa & Gusmão 2011; Barbosa et al. 2011, 2013; Silva & Gusmão 2013; Monteiro & Gusmão 2014; Moro et al. 2015; Fiuza et al. 2015a,b, 2016, 2017). These studies revealed a high biodiversity of facultative aquatic hyphomycetes and a large number of new taxa.

During studies on freshwater hyphomycetes on submerged decaying plant material, two interesting taxa were found with conidial morphologies that differed from those of any described species. One is described here as a new genus and species, *Dictyotrichocladium aquaticum*, and the other as a new species of *Minimelanolocus* R.F. Castañeda & Heredia, *M. aquatilis*.

Materials & methods

From November 2013 to August 2015, expeditions were made in Serra da Tromba (Chapada Diamantina, Bahia) and Serra da Fumaça (Pindobaçú, Bahia). Both areas belong to the semiarid region of northeastern Brazil.

In Serra da Tromba, submerged decaying leaves of *Calophyllum brasiliense* were collected from three streams in the Contas river basin, taken to the Laboratory of Mycology (LAMIC) in plastic bags, and processed as described by Bärlocher (2005). Leaf samples of *C. brasiliense* were washed, and 12 mm diam discs were cut with a cork borer. The discs were incubated for 48 hours at 18–20°C on a shaker (100 rpm) in 100 mL Erlenmeyer flasks containing 30 mL of sterile distilled water to induce sporulation. The spore suspensions were filtered through membrane filters (5 µm pore size), which were then mounted on slides with cotton blue in lactic acid. The leaf discs were mounted on slides with acid lactic and examined under compound microscope.

In Serra da Fumaça, submerged twigs were collected from some streams, taken to the Laboratory of Mycology (LAMIC) in plastic bags, and processed as described by Castañeda-Ruiz et al. (2016). The twigs were washed and placed in Petri dishes (moist chambers) incubated in a polystyrene box with sterile water plus glycerol for 30 days. The slides were mounted using resin PVL (polyvinyl alcohol, lactic acid and phenol). Measurements of reproductive structures and identification of specimens were performed using a compound microscope (Olympus BX51). The specimens were deposited in the Herbarium of Universidade Estadual de Feira de Santana, Bahia, Brazil (HUEFS).

Taxonomy

Dictyotrichocladium Fiuza, Gusmão & R.F. Castañeda, **gen. nov.**

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> Differs from *Trichocladium* by its long clavate, turbinate to vermiform, curved or sigmoid, dictyoseptate conidia.
>
> Type species: *Dictyotrichocladium aquaticum* Fiuza et al.
>
> Etymology: Greek, *dictyo-*, for conidia with one or more transversal and longitudinal and/or oblique septa; Latin, *-trichocladium*, referring to the genus *Trichocladium*.

Conidiophores micronematous or macronematous, unbranched, septate, brown. Conidiogenous cells monoblastic, integrated, terminal, pale brown to brown. Conidial secession schizolytic. Conidia solitary, long pyriform, cylindrical, long clavate, turbinate to vermiform, curved or sigmoid, dictyoseptate, brown to dark brown.

Notes—*Dictyotrichocladium* is similar to *Trichocladium* Harz, which differs by its didymo- or phragmoconidia (Hughes 1952). Several other genera including *Acrodictys* M.B. Ellis, *Cirrenalia* Meyers & R.T. Moore, *Paradictyoarthrinium* Matsush., and *Thyrostroma* Höhn. have conidia similar to *Dictyotrichocladium*. However, *Acrodictys* produces cylindrical, pyriform, obovoid or ovoid and straight conidia (Zhao et al. 2011). *Cirrenalia* is close to *Dictyotrichocladium* in conidial shape but differs in its helicoid phragmoconidia (Zhao & Liu 2005). In *Paradictyoarthrinium*, the conidiophores are slightly constricted at the septa or monilioid, and conidiogenous cells are lateral or intercalary (Matsushima 1996, Seifert et al. 2011). *Thyrostroma* has stromatic, sporodochial conidiomata, and its conidiogenous cells are indeterminate with several enteroblastic percurrent generations (Höhnel 1911). *Dictyodesmium* S. Hughes and *Dictyorostrella* U. Braun also have dictyoseptate conidia, but both genera have stromatic, sporodochial conidiomata (Seifert et al. 2011).

Dictyotrichocladium aquaticum Fiuza, Gusmão & R.F. Castañeda, **sp. nov.** Fig. 1

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> Differs from *Trichocladium* spp. by its long clavate to vermiform, curved or sigmoid, dictyoseptate conidia.
>
> Type: Brazil, Bahia: Piatã, Chapada Diamantina, Serra da Tromba, 13°05′S 41°51′W, alt. 1272 m, on submerged decaying leaves of *Calophyllum brasiliense* Cambess. (*Calophyllaceae*) in a river, 5 June 2015, coll. P.O. Fiuza (**Holotype**, HUEFS 215954).
>
> Etymology: Latin, *aquaticum*, referring to the aquatic environment where the species grows.

Colonies on natural substrate effuse, brown to dark brown. Mycelium superficial and immersed, composed of slightly branched, septate, smooth,

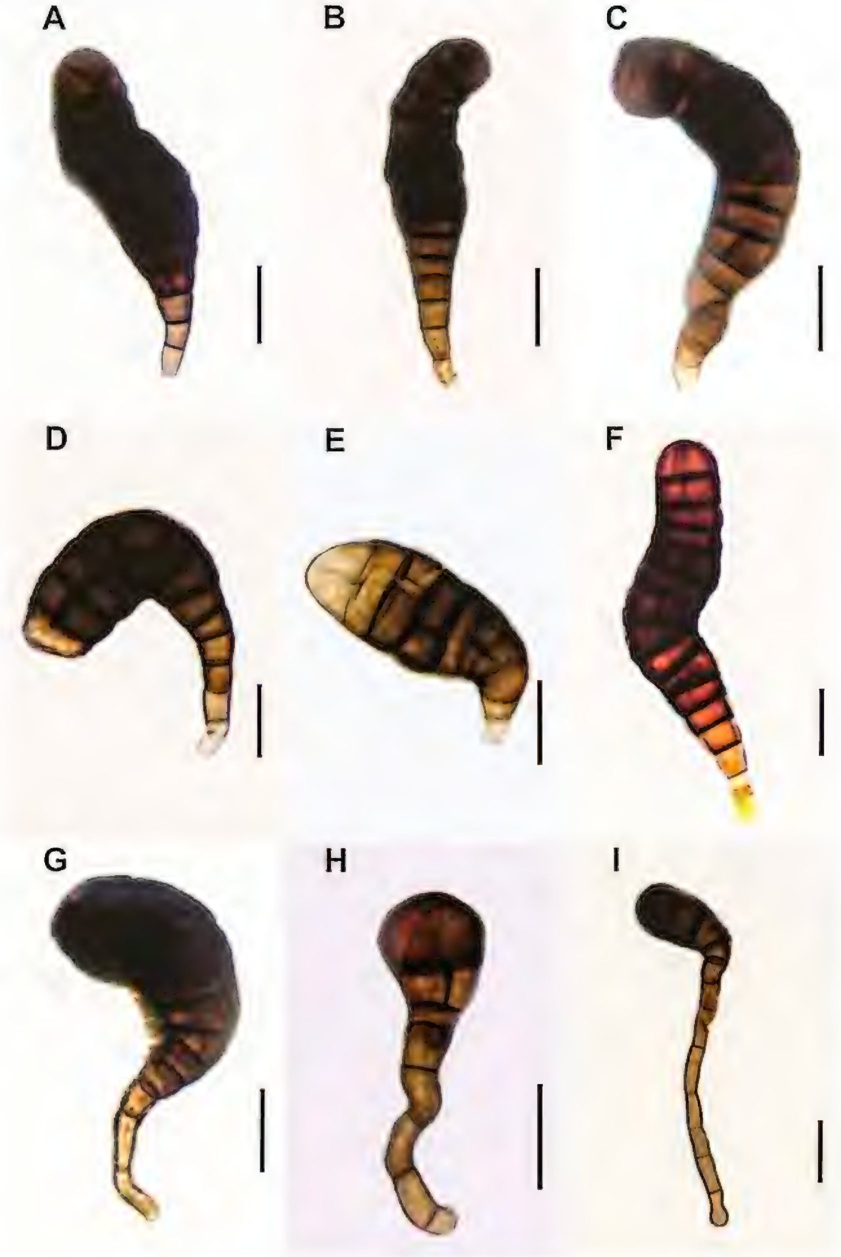

FIG. 1. *Dictyotrichocladium aquaticum* (holotype, HUEFS 215954). A–F. Conidia; G–I. Conidiophores, conidiogenous cells, and conidia. Scale bars = 20 µm.

pale brown to brown hyphae, 2–4.5 µm diam. CONIDIOPHORES micronematous or macronematous, single, erect, straight or flexuous, unbranched, 2–8-septate, smooth, 20–80 × 6–7.5 µm, brown. CONIDIOGENOUS CELLS monoblastic, integrated, terminal, smooth, 6–10 × 7–9 µm, pale brown to brown. CONIDIAL SECESSION schizolytic. CONIDIA solitary, long pyriform, cylindrical, long clavate, turbinate to vermiform, curved or sigmoid, dictyoseptate, smooth, 30–140 × 18–37.5 µm, brown to dark brown, dry.

Minimelanolocus aquatilis L.B. Conc., M.F.O. Marques, Gusmão & R.F. Castañeda, **sp. nov.** FIG. 2

MYCOBANK MB821640

Differs from *Minimelanolocus limpidus* by its smaller conidiophores and verruculose conidia.

TYPE: Brazil, Bahia: Pindobaçú, Serra da Fumaça, 10°38′S 40°22′W, alt. 865 m, on submerged decaying twigs of unidentified plant in a stream, 8 August 2015, coll. L.B. Conceição (**Holotype**, HUEFS 216640).

ETYMOLOGY: Latin, *aquatilis*, refers to its capacity or ability to live in water.

COLONIES on natural substrate effuse, hairy, brown. Mycelium superficial and immersed, composed of slightly branched, septate, smooth, brown hyphae, 2–4 µm diam. CONIDIOPHORES macronematous, mononematous, single or caespitose, erect, straight or flexuous, unbranched, 1–5-septate, think-walled, smooth, 43–78 × 5–10 µm, brown to pale brown at the apex. CONIDIOGENOUS CELLS polyblastic, integrated, terminal, indeterminate, with several sympodial extensions, 20–42 × 5–7 µm, brown to pale brown. CONIDIAL SECESSION schizolytic. CONIDIA solitary, acropleurogenous, dry, 3–5-euseptate, broadly obclavate, verruculose, 21–30 × 5–8 µm, pale brown to subhyaline, with small dark scar at the truncate base, 1.5–2 µm wide.

NOTES—*Minimelanolocus* currently comprises 29 species (Castañeda-Ruiz et al. 2001, Heredia et al. 2014, Liu et al. 2015, Hyde et al. 2016), most of which were found as saprobes on decaying leaves, rotten wood, dead branches, and bamboo in a terrestrial environment; only five species have been reported from aquatic habitats (Liu et al. 2015, Hyde et al. 2016). *Minimelanolocus aquatilis* is superficially similar to *M. limpidus* Heredia et al., which has smooth-walled and longer (27–48 µm) conidia (Heredia et al. 2014).

Discussion

Facultative aquatic hyphomycetes have been recorded in Brazil since 2011 (Barbosa et al. 2013). Thus far, 339 species are distributed in Amazon, Caatinga, and Atlantic Forest (Fiuza et al. 2016, 2017); of these, 25 were described as

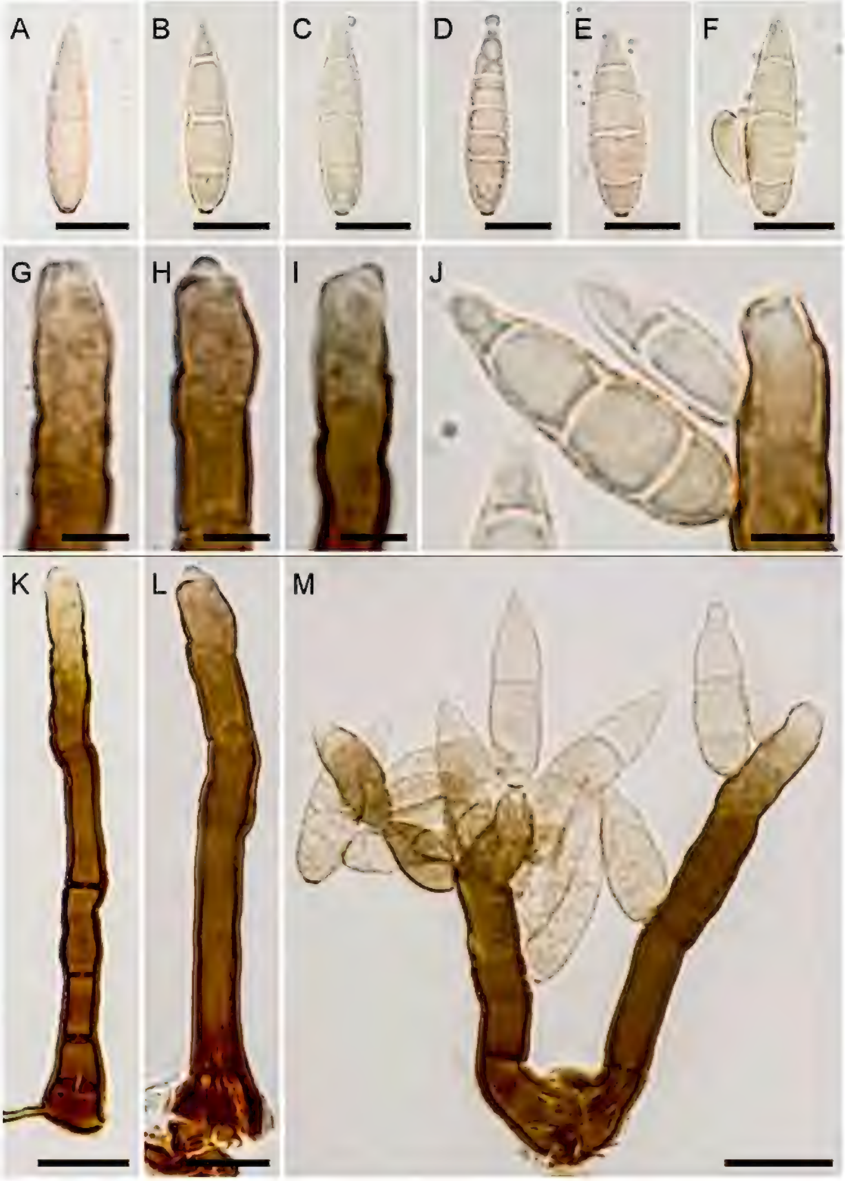

Fig. 2. *Minimelanolocus aquatilis* (holotype, HUEFS 216640). A–F. Conidia; G–I. Conidiogenous cells; J. Conidiogenous cell and conidia; K, L. Conidiophores; M. Conidiophores, conidiogenous cells, and conidia. Scale bars: A–F, K–M = 10 µm; G–J = 5 µm.

new species: 15 from Amazon, 1 from Atlantic Forest, and 9 from Caatinga (Barbosa et al. 2011, 2013; Silva & Gusmão 2013; Monteiro & Gusmão 2014; Fiuza et al. 2015a,b, 2016; Moro et al. 2015; Conceição et al. 2016; Monteiro et al. 2016), including the type species of a new genus, *Dictyoaquaphila* J.S. Monteiro et al., from Amazon and Caatinga (Monteiro et al. 2016). The present study yielded another new species, *Minimelanolocus aquatilis* and a new genus, *Dictyotrichocladium*, to Caatinga.

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